Use of the Transient Plane Source Technique for Multiple Thermal Property Measurements

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There is a growing need across a range of industries for rapid, compact and preferably in-situ devices for measurement of thermophysical properties. More typically, thermal properties are measured using laboratory-based apparatus designed for particular property ranges and materials.

The Gustafsson probe is a commercial compact instrument that employs a transient plane heater/sensor combination to measure the thermal properties of materials. The sensor consists of an electrically conducting double spiral which has been etched out of a thin nickel foil. This spiral is sandwiched between two thin sheets of an insulating material, either Kapton for use from cryogenic temperatures to about 500 K or mica from 500 K to 1000 K. The probe covers a wide range of thermal conductivities (from 0.02 $Wm^{-1}K^{-1}$ to 200 $Wm^{-1}K^{-1}$) and temperatures (cryogenic to 1000 K) and provides values for thermal conductivity, thermal diffusivity and specific heat capacity.

This paper describes the work at NPL to evaluate the capability of the Transient Plane Source (TPS) technique with various sensor sizes and types of material that include solids (ice and extruded polystyrene), liquids (water, agar-agar and silicone oil) and biological materials (pig muscle, fat and skin).